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ORIGINAL ARTICLE

Mesh repair for postoperative wound dehiscence in the presence of infection: is absorbable mesh safer than non-absorbable mesh?

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Abstract
Objective In patients with postoperative wound dehiscence in the presence of infection, extensive visceral oedema often necessitates mechanical containment of bowel. Prosthetic mesh is often used for this purpose. The aim of the present study was to assess the safety of the use of non-absorbable and absorbable meshes for this purpose.
Method All patients that had undergone mesh repair of abdominal wound dehiscence between January 1988 and January 1998 in the presence of intra-abdominal infection were included in a retrospective cohort study. All surviving patients had physical follow-up in February 2001.
Result Eighteen patients were included in the study. Meshes consisted of polyglactin ($n = 6$), polypropylene ($n = 8$), polyester ($n = 1$), or a combination of a polypropylene mesh with a polyglactin mesh on the visceral side ($n = 3$). All patients developed complications, consisting mainly of mesh infection (77%), intra-abdominal abscess (17%), enterocutaneous fistula (17%), or mesh migration through the bowel (11%). Mesh removal was necessary in eight patients (44%). Within four months postoperatively, six patients (33%) had died because of progressive abdominal sepsis. The incidence of progressive abdominal sepsis was significantly higher in the group with absorbable polyglactin mesh than in the group with nonabsorbable mesh (67 vs. 11%, $p = 0.02$) After a mean follow-up of 49 months, 63% of the surviving patients had developed incisional hernia. Absorbable meshes did not yield better outcomes than nonabsorbable meshes in terms of complications and mortality rate.
Conclusion Synthetic graft placement in the presence of intra-abdominal infection has a high risk of complications, regardless of whether absorbable (polyglactin) or non-absorbable mesh material (polypropylene or polyester) is used, and should be avoided if possible.

Keywords Mesh · Infection · Wound dehiscence · Absorbable · Non-absorbable

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Introduction

Wound dehiscence, defined as postoperative disruption of all layers of the abdominal wall, occurs in 0.25–3% of all patients after abdominal surgery, and is associated with high morbidity and 10–40% mortality [1,2]. Intra-abdominal infection is present in up to 40% of these patients [3].

Patients with postoperative wound dehiscence in the presence of infection or contamination represent a difficult and challenging problem to the surgeon. In these patients, the bowel is often oedematous and protrudes from the abdominal cavity. Evisceration of this oedemateus bowel precludes primary closure of the abdominal wall and necessitates other methods of mechanical control.

Currently, one of the methods most commonly used to mechanically contain the contents of the abdomen in these patients is the use of prosthetic mesh. However, concern exists about mesh-related complications, such as mesh extrusion and enteric fistula formation [4–7]. Several authors have suggested that the occurrence of these complications is particularly associated with the use of non-resorbable mesh and could be prevented through the use of

an absorbable mesh [8–11]. However, only limited data on this subject are available.

The present study was performed in order to determine the safety of the use of non-absorbable and absorbable meshes for wound dehiscence repair in the presence of infection.

Methods

In a retrospective study, all patients that had undergone mesh repair of acute postoperative wound dehiscence between January 1988 and January 1998 at the Erasmus University Medical Centre in Rotterdam were selected for analysis [3]. Wound dehiscence was defined as moderate when there was only serosanguinous leakage through the abdominal defect without evisceration. Dehiscence was defined as severe when evisceration had occurred. Evisceration was defined as protrusion of bowel beyond the abdominal wall.

All patients with signs of intra-abdominal infection (defined as intra-abdominal pus and/or a positive bacterial culture from the abdomen) at the time of mesh placement were included in the study. Data regarding patient characteristics, initial surgical procedures, procedure of mesh placement, postoperative complications, microbiological findings, antibiotic therapy and late complications were recorded.

There were no consistent guidelines on the use of mesh and the choice of mesh material. In general, patients with large defects requiring great tension to close were primarily selected for mesh repair. If fascial necrosis was present, necrotectomy was performed before graft placement. If possible, the omentum was placed in-between the mesh and the viscera.

Postoperative mesh infection was defined as discharge of pus from the mesh, confirmed by positive bacterial culture from the mesh. Postoperative progressive abdominal sepsis was defined as progressive sepsis with positive blood cultures of enteric bacteria.

At the time that the study was conducted (February 2001), every surviving patient underwent a physical examination of the abdominal wall at the outpatient department, with special emphasis placed on searching for the presence of incisional hernia. To achieve this, the abdomen was examined in both upright and horizontal positions during the Valsalva manoeuvre. The follow-up period was defined as the time interval between mesh placement and the last physical examination that was performed.

Statistical analysis was performed using the Mann–Whitney U-test for independent samples. A p-value of less than 0.05 was considered to be statistically significant.

Results

During the study period, a total of 168 patients underwent wound dehiscence repair. Of these, 26 patients had mesh repair of wound dehiscence, of whom 18 patients had repair in the presence of intra-abdominal infection. Thus, eighteen patients (twelve males and six females, with a mean age of 61 years, range 31–89) were included in the study.

The mean number of abdominal operations that preceded the procedure of mesh placement was two (range 1–5). In the patients with wound dehiscence, underlying causes of abdominal infection were gastric perforation ($n = 2$), Boerhaave syndrome ($n = 1$), perforated diverticulitis ($n = 3$), pancreatitis ($n = 1$), contaminated initial procedure with bowel surgery for malignancy or gastrointestinal bleeding ($n = 8$), strangulated bowel in a femoral hernia ($n = 1$), inadvertent gallbladder perforation ($n = 1$) and the occurrence of wound infection after surgery for acute aneurysm of the abdominal aorta ($n = 1$). Severity of dehiscence was moderate in one patient and severe (with evisceration) in 17 patients.

At the time of mesh placement, clinical signs of infection (pus coming out of the wound, temperature elevation and/or high white blood cell count) had been present for a mean of ten days (range 0–22 days). At the time of mesh placement, bacteriaemia (confirmed with positive blood culture) was present in three patients.

Broad-spectrum antibiotic therapy was administered at the start of each surgical procedure in which a mesh was placed. None of the mesh patches was impregnated with antibiotics. Graft materials included polyglactin ($n = 6$), polypropylene ($n = 8$) and polyester ($n = 1$). In another three patients, a polypropylene mesh was combined with a polyglactin mesh on the visceral side. The skin was left open in all patients.

Complications

Mean postoperative hospital stay was 53 days (range 1–142 days). Postoperative complications and comparison of complications for absorbable or non-absorbable mesh material are shown in Table 1.

Fifteen patients developed mesh infection (77%), which was bacteriologically confirmed in all cases. A total of 18 different species of pathogens were recovered from the abdominal cavities postoperatively (Table 2). There was no difference between the use of absorbable or non-absorbable mesh in terms of the incidence of mesh infection. Mesh infection was initially treated by broad-spectrum antibiotics in all patients. In eight patients, however, this was not successful and the mesh had to be removed. In three patients, mesh infection was associated with intra-abdominal abscesses, which were surgically drained.

Table 1 Comparison of postoperative complications between absorbable, non-absorbable and a combination of absorbable plus non-absorbable mesh materials

Complication	Absorbable (polyglactin) ($n = 6$)	Non-absorbable (polypropylene or polyester) ($n = 9$)	Combination (polypropylene + polyglactin) ($n = 3$)	p-value	Total ($n = 18$)
Complications					
Clinical signs of mesh infection	67%	89%	67%	n.s.	77%
Enterocutaneous fistula		22%	33%	n.s.	17%
Bowel perforation due to mesh migration	17%	11%		n.s.	11%
Intra-abdominal abscess	33%	11%		n.s.	17%
Ileus		22%		n.s.	11%
Urinary tract infection	17%	11%		n.s.	11%
Intra-abdominal bleeding			33%	n.s.	6%
Pulmonary complications	17%	11%	33%	n.s.	17%
Gastro-intestinal bleeding		11%		n.s.	6%
Mesh removed	33%	56%	33%	n.s.	44%
Total mortality	**83%**	**33%**	**33%**		**56%**
Cause of death					
Progressive abdominal sepsis	67%	11%	33%	$p = 0.02$[a]	33%
Cardiopulmonary complications	17%	11%		n.s.	11%
Cerebrovascular accident		11%		n.s.	11%
Peritonitis carcinomatosa		11%		n.s.	6%
Incisional hernia in surviving patients	100%	67%	0%	n.s.	63%

n.s. not statistically significant

[a] comparison between absorbable and non-absorbable materials

Two patients developed enterocutaneous fistulas. In the first patient, two enterocutaneuous fistulas had developed five months after placement of a combined polypropylene with polyglactin mesh. In the second patient, the fistula was diagnosed 18 months after the use of a polyester mesh. In both patients, the mesh was removed and partial bowel resection was performed.

In two other patients, the mesh had migrated through and thus perforated the bowel. An absorbable polyglactin mesh had been used in one of these patients. Despite removal of the mesh with partial bowel resection and several relaparotomies with abscess drainage, this patient died at 71 days postoperatively due to progressive abdominal sepsis. In the other patient, a polypropylene mesh had migrated through the bowel and recurrent wound dehiscence had occurred. In this patient, the mesh was removed and a partial bowel resection was performed successfully.

In four patients, after mesh removal, a new mesh composed of polypropylene ($n = 3$) or ePTFE (ethylpolytetrafluoroethylene, $n = 1$) was placed into the defect. Of these patients, two were reoperated and had their mesh removed again. Reasons for mesh removal in these patients were the presence of an enterocutaneous fistula at nine months after placement of a polypropylene mesh, and infection of an ePTFE mesh, which did not respond to antibiotic therapy.

Postoperatively, two patients developed ileus. In one patient, the ileus could be treated successfully with conservative therapy, but in the other patient reoperation was indicated. In this patient, adhesiolysis of dense bowel adhesions to a polypropylene mesh was performed.

Six patients died due to progressive abdominal sepsis (at a range of 1–126 days postoperatively). The incidence of this complication was significantly higher in the group with absorbable polyglactin mesh than in the group with non-absorbable mesh (67 vs. 11%, $p = 0.02$, Table 1).

By the time that the study was conducted ten patients had died (Table 1). All patients who were still alive underwent physical examinations at the outpatient department, except for one patient who could not be traced (13%). After a mean follow-up of 49 months (range 8–133 months), five of these patients had developed incisional hernia (63%, Table 1).

Discussion

As shown by the present study, prosthetic mesh placement in patients with wound dehiscence in the presence of intra-abdominal infection has a high risk of complications, regardless of whether non-absorbable or absorbable mesh is used.

Table 2 Pathogens recovered from the abdomen

Pathogen	No. of patients with these pathogens
Aerobic pathogens	
Escherichia coli	13
Enterococcus sp.	5
Staphylococcus aureus	8
Staphylococcus epidermidis	4
β-Hemolytic streptococcus	3
Corynebacterium sp.	1
Acinobacter sp.	2
Proteus sp.	4
Pseudomonas sp.	12
Streptococcus sp.	1
Enterobacter sp.	7
Klebsiella sp.	4
Bacillus sp.	1
Morganella morganii	3
Serratia marcescens	3
Anaerobic pathogens	
Bacteroides sp.	1
Mycosis	
Candida sp.	7

Polypropylene mesh is not absorbable and is the material most widely used for abdominal wall replacement and reinforcement during hernia repair. Favourable characteristics of polypropylene include its durability, pliability, high tensile strength, and good growth of fibroblasts into the mesh [12,13]. Further, some authors have suggested that if the polypropylene mesh gets infected, this can generally be treated adequately with drainage and antibiotics, without the need for removal of the mesh [12,14]. However, this was not found in the present study, in which 56% of the meshes had to be removed, despite antibiotic therapy. In addition, as shown in the present study, the use of polypropylene mesh in a contaminated environment is associated with a high incidence of serious complications, such as mesh migration through the bowel (11%), ileus due to adhesion of bowel to the mesh (11%), and enteric fistulation (22%). This was also found by other authors who noted a fistula rate of 12–50% [4,15–18].

Polyglactin and polyglycolic acid meshes are both rapidly absorbable. They can temporarily restore abdominal wall continuity, but when the mesh has been absorbed, all patients will inevitably develop incisional hernia, as confirmed by the present study [8,11,19,20].

Several authors have suggested that the use of absorbable meshes would reduce the occurrence of mesh-related chronic complications [8–11]. However, as shown by the present study, the use of absorbable polyglactin mesh was associated with an incidence of mesh migration through the bowel that was comparable to that of polypropylene mesh (17 vs. 11%). Further, enterocutaneous fistulas still developed despite placement of a polyglactin mesh on the visceral side of a polypropylene mesh. In addition, the incidence of mortality due to persistent abdominal sepsis was even higher in the group of patients with absorbable polyglactin meshes compared to non-absorbable polypropylene meshes. Since this is a retrospective study, there may be a bias in patient selection. However, a factor that may contribute to the high incidence of progressive abdominal sepsis with the use of absorbable polyglactin mesh is the multifilament structure of this mesh compared to the monofilament structure of the polypropylene mesh. It is known that multifilament material is more susceptible to infection than monofilament material, and the use of a multifilament foreign body in an infected environment may increase bacterial load on the mesh [21–23].

Several authors have attempted to develop alternatives for the temporary containment of abdominal contents in the presence of large contaminated abdominal wall defects that do not use prosthetic mesh [24–28]. Ghimenton et al. used an empty, sterile, 1- or 3- litre plastic bag, as used for intravenous fluid administation or for urological irrigation, which was stitched with a continuous suture to the edges of the rectus sheath or the skin [25]. When no relaparotomy was needed, the plastic bag was removed and split skin grafting was performed. However, all surviving patients developed incisional hernias, which were demanding to repair. Further, massive bowel adherence to the broad midline granulation area with skin graft still posed a small risk of fistula formation, which was seen in 2 out of 75 patients [25].

Koniaris et al. described the "dynamic retention technique" [24]. With this technique, a bowel bag is used to cover the bowel and omentum. Moistened burn dressings are placed flatly over the bowel bag, and four or five horizontal retention sutures are placed over this dressing, on top of which a second layer of dressings is added with a drainage catheter. In the ICU, retention sutures may be tightened and delayed primary fascial closure can be achieved. No fistulas were seen and only one out of ten patients developed incisional hernia [24].

Recently, a new device was developed for temporary abdominal closure, the VAC® abdominal dressing. With this technique, foam that is encapsulated within a non-adhesive layer is placed over the bowel and covered with a drape. This is connected to a vacuum suction system that creates a local negative pressure on the wound, thereby enabling evacuation of abdominal fluids. Since the non-adhesive layer is placed under the fascia, the bowel cannot adhere to the fascia and so the surgeon can approximate the fascia after several days if the intra-abdominal swelling is reduced. Although first results with this device are promising, its use requires further study and evaluation [29,30].

Another alternative is to use biological meshes. These meshes, composed of small intestinal submucosa (SIS), porcine dermal collagen, bovine pericardium or human acellular tissue, become an integral part of the body. They are advocated by some authors for use in operations with a high risk of infection because they provide the specific advantage of resistance to superficial wound infections [31–33]. However, these biological mesh implants are fairly costly and additional clinical studies are required to evaluate their efficacy.

In conclusion, the present study shows that synthetic graft placement in the presence of intra-abdominal infection has a high risk of complications, regardless of whether absorbable polyglactin mesh or non-absorbable polypropylene or polyester mesh is used. Use of absorbable mesh material was even associated with a significantly increased incidence of progressive abdominal sepsis compared to non-absorbable mesh material. Therefore, use of "conventional" mesh under contaminated circumstances should be avoided if possible, and alternatives such as the dynamic retention method, VAC abdominal dressing closure and use of biological meshes should be explored. Prospective randomised trials are required to determine the best approach to use in order to manage large infected abdominal wall defects.

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